

REMARKS

Non-elected claims 9-10 and 26-29 have been canceled. Thus, elected method claims 1-3 and 15-25 are pending for further prosecution in the present application. Independent claims 1-3 have each been amended to distinguish over the prior art of record. No new matter was added. Accordingly, Applicants respectfully submit that the present application is in condition for allowance.

I. Restriction Requirement

In the Office Action, restriction is required between Group I claims directed to a method of sintering and Group II claims directed to a sintering device.

Applicants affirm the election of the Group I method claims, which include claims 1-3 and 15-25. The Group II claims, 9-10 and 26-29, have been canceled.

II. Claim Rejections - 35 USC §112, Second Paragraph

In the Office Action, claims 18, 21 and 25 are rejected under 35 USC §112, second paragraph, as being indefinite.

The term “long sintering powder material” (which is stated in the specification, as filed, on page 5, line 4) has been deleted from claims 18, 21 and 25. These claims now require the formation of an elongate rod-shaped sintered body or an elongate sintered body having an uneven cross-section. No new matter was added. For example, see the last sentence of the first paragraph of page 1 of the present application, as filed.

Applicants respectfully request reconsideration and removal of the above stated rejection of claims 18, 21 and 25.

III. Claim Rejections - 35 USC §102(b)

- A. *In the Office Action, claims 1, 2 and 15-21 are rejected under 35 USC §102(b) as being anticipated by JP 2001-335811A.*

JP 2001-335811A is illustrative of the type of prior art discussed on the third paragraph of page 1 of the present application, as filed. In this type of method, the electrodes are disposed on opposite axial ends of the molding space. Thus, both pressure and heat are applied via the ends of the molding space. The disadvantages of such an arrangement is discussed in the last paragraph on page 1 to page 2, line 12, of the present application, as filed.

More specifically, Paragraph No. 0008 of JP '811 discloses a "lower energization electrode" (141) having an "electrode head" (144) and an "upper energization electrode" (151) having an "electrode head" (154). See FIG. 1 of JP '811 for the arrangement of the upper and lower electrode heads (154 and 144) on opposite sides of the "sintering mold" (a) filled with "powder" (j). As described in Paragraph No. 0011 of JP '811, the electrode heads (144 and 154) provide pressure on each end of the cavity of mold (a) to pressurize and electrify the powder (j) from upper and lower ends thereof.

As discussed in the present application, a drawback of the technology of JP '811 is that current flows between the electrodes through the entire mass of powder contained within the mold from top to bottom. Heating is maximum where the powder contacts the electrodes and is less within powder spaced furthest from the electrodes. Consequently, there will be a difference in heating temperature within different portions of the powder. Although such uneven sintering temperatures may not cause a problem when manufacturing a short, or relatively thin, sintered compact, it does cause a problem with respect to manufacturing relatively long sintered bodies, such as rod-shaped sintered bodies. For example, it is not possible to sinter the entire mass of

powder with even temperature in a case where the powder is placed within an elongate, rod-shaped mold cavity.

In comparison, the present invention uses an elongate mold, such as a cylindrical mold, to form elongate, rod-shaped sintered bodies (in some cases the sintered bodies have uneven cross-sections). The electrodes are mounted on the side wall of the mold and apply energy transversely across the mold, and the entire mass of powder within the mold is compressed with pressure applied from the ends of the mold. Thus, energy provided to the powder from the electrodes is perpendicular to the loading axis.

Further, the height of the electrode of the present invention delineates the region of the powder being heated. For purposes of being able to heat the entire length of the powder, the electrode is capable of traveling lengthwise along the sidewall of the elongate mold in the direction of the loading axis while remaining in electrical contact with the side wall of the mold. Thus, the electrodes can be used to sinter powder within an elongate mold by sintering a section of the powder at a time and by continuously or successively moving the electrode to different sections. Such a process can be repeated or continued such that all sections of powder within an elongate mold are sintered from one end of the powder to the other. This method enables the sintering temperature to be precisely controlled at each section thereby making it possible to produce elongated rod-shaped sintered bodies under equal thermal conditions throughout the entire length of the body, regardless of the length of the body.

Claim 1 of the present application, as amended, requires the steps of arranging an electrode at the periphery of a side wall of a cylindrical mold having a rod-shaped molding space; heating and sintering a sintering subject in the rod-shaped molding space by energizing the electrode; pressurizing sintering powder material of the sintering subject disposed in the rod-shaped molding space from an end of the mold; and moving the electrode relative to the mold in

the lengthwise direction of the mold. Sintering is effected by continuously sintering the sintering powder material in the cylindrical mold from one end to the other end of the mold with sintering temperature being precisely controlled at each position of the electrode relative to the mold. No new matter was added. For example, see the first paragraph on page 7 and page 17, lines 5-18, of the present application, as filed.

Applicants respectfully submit that JP '811 fails to disclose a method that includes the step of arranging an electrode at the periphery of a side wall of a cylindrical mold having a rod-shaped molding space and the step of moving the electrode relative to the mold in the lengthwise direction of the mold to a plurality of positions along the length of the mold. JP '811 also clearly fails to disclose the requirement of sintering the powder in the cylindrical mold from one end to the other end of the mold with sintering temperature being precisely controlled at each position of the electrode relative to the mold.

For at least these reasons, Applicants respectfully submit that JP '811 does not anticipate claim 1, as amended, of the present application. Claim 2, as amended, contains similar limitations discussed above with respect to claim 1. Accordingly, Applicants request reconsideration and removal of the above referenced anticipation rejection of claims 1, 2 and 15-21.

B. In the Office Action, claims 1-3 and 15-25 are rejected under 35 USC §102(b) as being anticipated by U.S. Patent No. 6,610,246 B1 issued to Sunamoto.

As discussed above in greater detail, the claims, as amended, of the present application require an electrode to be moved along the length of an elongate mold so that sintering at any given time is only applied to a fraction of the total length of the powder within the elongate mold. This enables precise control of sintering temperatures throughout the full length of

elongate rod-shaped sintered bodies as well as elongate bodies having uneven transverse cross sections.

Turning to the cited reference, Sunamoto discloses two sets of opposing electrodes arranged around a mold and a process in which the supply of current to the electrodes is alternated or switched between each of the respective sets. The purpose of this arrangement and process is to alter the conductive point so that it is thereby possible to prevent the occurrence of partial differences in temperature.

Although Sunamoto arranges sets of electrodes along a side face of the mold, the electrodes and molding space provided by the mold are maintained at the same position relative to the height and/or length of the mold. Thus, unlike the present invention, there is no movement of the electrodes relative to the mold along the length of the mold. Accordingly, the technology of Sunamoto cannot continuously sinter an elongate, rod-shaped sintered compact and its electrodes are not moved lengthwise relative to the mold from a sintered powder portion to a non-sintered powder containing portion of the mold.

The present invention discloses a method of placing powder in a cylindrical mold and sintering this with pressure and heat. The initial area of the powder heated is a partial, narrow, local area that extends transversely across the elongate cylindrical mold. This local heating area is moved as the electrode is moved along the length of the mold. Accordingly, relatively narrow bands of powder in the mold are sequentially sintered based on the movement of the heating area along the length of the mold. Ultimately, the entire powder within a relatively elongate, cylindrical mold is sintered to produce an elongate, rod-shaped, evenly-sintered compact according to the present invention. This is entirely different from the teaching of Sunamoto which provides for no movement of the electrodes along the length of the mold and/or production of an elongate, rod-shaped compact that is evenly sintered.

Further, as best illustrated in FIGs. 11 and 12 of the present application and as claimed in claim 3, the present invention can be used to manufacture a rod-shaped sintered compact in which the transverse cross-section changes and/or is uneven or stepped. The Sunamoto patent cannot be used to produce an evenly sintered body having such a shape.

For at least these reasons, Applicants respectfully submit that JP '811 does not anticipate claims 1-3, as amended, of the present application. Accordingly, Applicants request reconsideration and removal of the above referenced anticipation rejection of claims 1-3 and 15-25.

IV. Conclusion

In view of the above amendments and remarks, Applicants respectfully submit that the claim rejections have been overcome and that the present application is in condition for allowance. Thus, a favorable action on the merits is therefore requested.

Please charge any deficiency or credit any overpayment for entering this Amendment to our deposit account no. 08-3040.

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